

FIG. 1

INVENTOR: Wang et al.
TITLE: Method and Apparatus for Directional Resistivity...
ATTORNEY: G. Michael Roebuck TELEPHONE NO.: 713-266-1130
EXPRESS NO.: EV322404402US DOCKET NO.: 414-28483-US
SHEET 2 OF 10

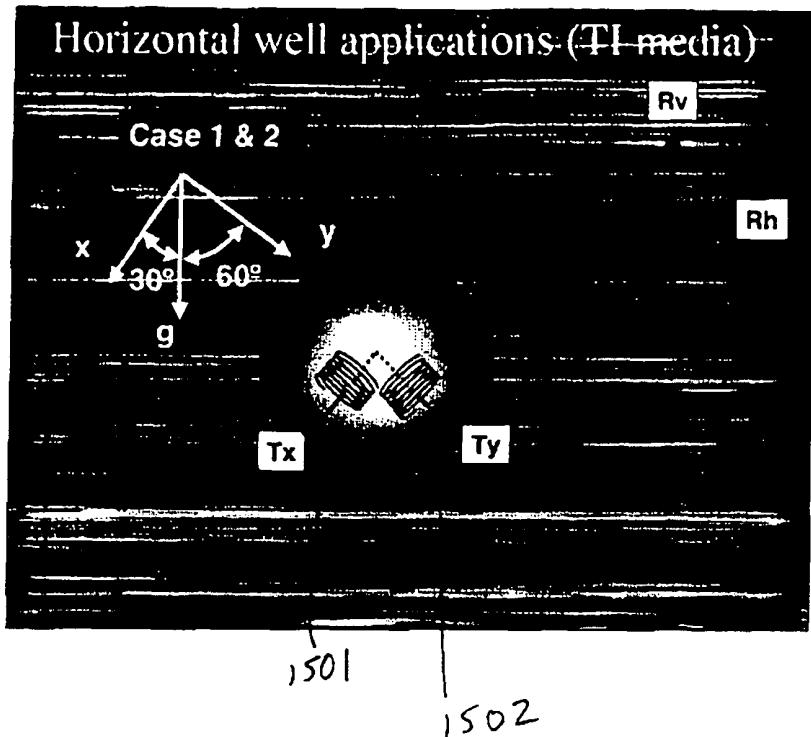
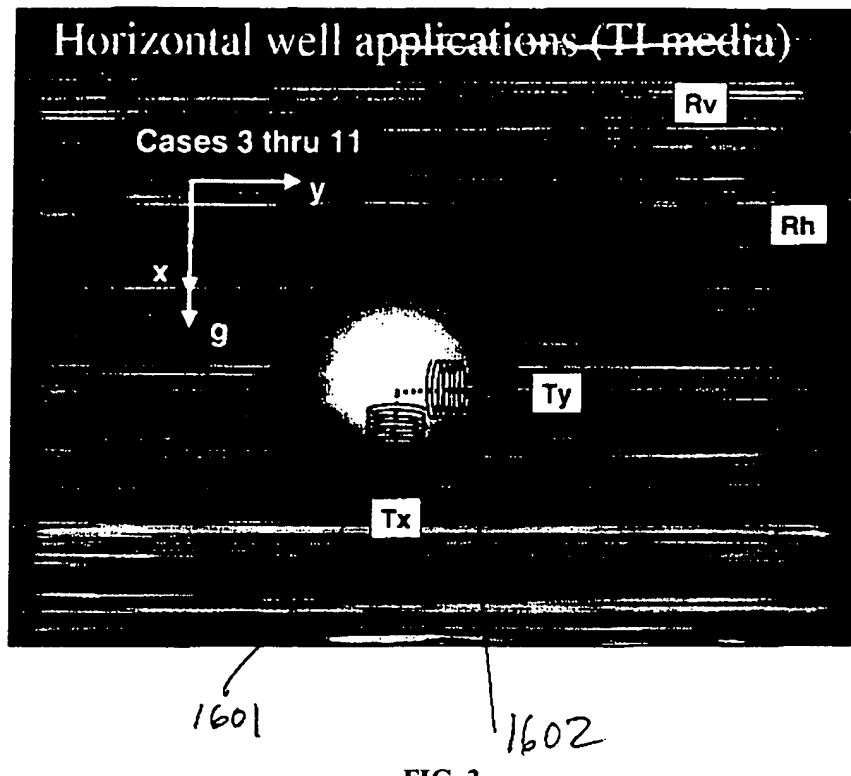


FIG. 2

INVENTOR: Wang et al.
TITLE: Method and Apparatus for Directional Resistivity...
ATTORNEY: G. Michael Roebuck TELEPHONE NO.: 713-266-1130
EXPRESS NO.: EV322404402US DOCKET NO.: 414-28483-US
SHEET 3 OF 10



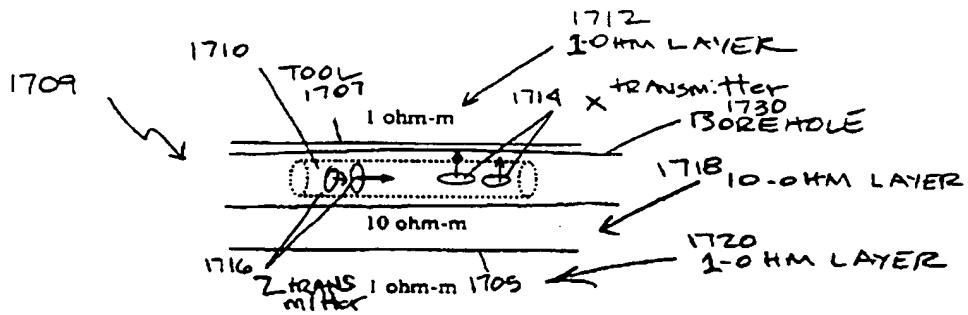


FIG. 4 Diagram showing a Z-transmitter (horizontal) and an X-receiver (vertical) in a three-layer formation. The 10-ohmm layer is 10 ft thick.

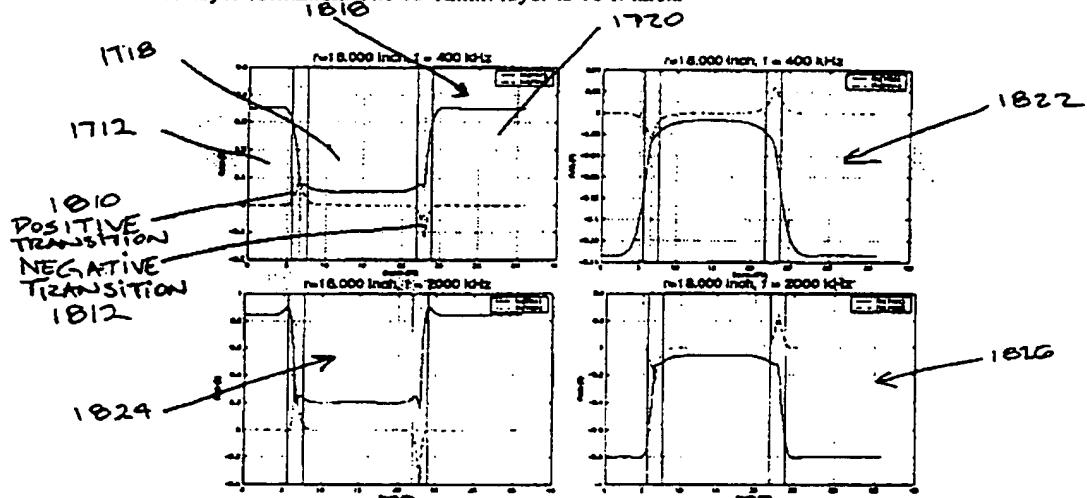


FIG. 5 The magnetic field (real and imaginary parts) for the ZX transmitter and receiver configuration in the three-layer formation shown in Figure 1. The 'tool' axis is parallel to the bed boundaries.

INVENTOR: Wang et al.
TITLE: Method and Apparatus for Directional Resistivity...
ATTORNEY: G. Michael Roebuck TELEPHONE NO.: 713-266-1130
EXPRESS NO.: EV322404402US DOCKET NO.: 414-28483-US
SHEET 5 OF 10

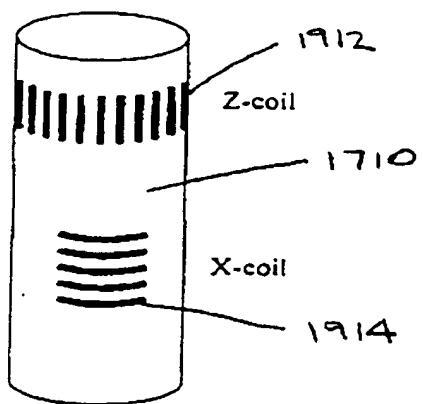


FIG. 6 Arrangement of 'horizontal' grooves to host a transverse (X-) coil. Also shown are vertical grooves used in the current MPR tool to host a Z-coil.

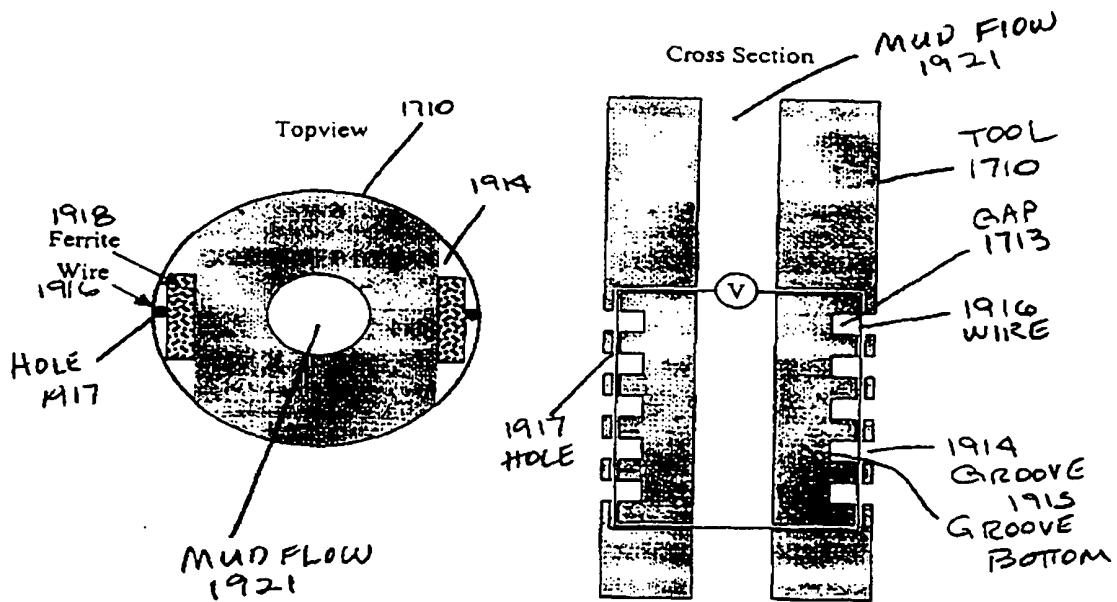


FIG. 7 The top view of a groove with wire and ferrite and the cross-sectional structure of the transverse loop.

INVENTOR: Wang et al.
TITLE: Method and Apparatus for Directional Resistivity...
ATTORNEY: G. Michael Roebuck TELEPHONE NO.: 713-266-1130
EXPRESS NO.: EV322404402US DOCKET NO.: 414-28483-US
SHEET 7 OF 10

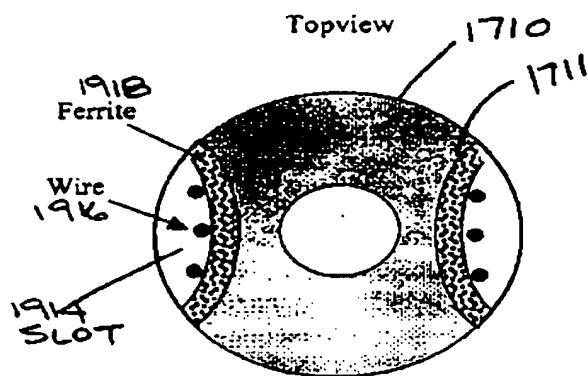


FIG. 8 The top view of a general groove design showing multiple wires backed by a curved ferrite layer on top of the pipe metal.

INVENTOR: Wang et al.
TITLE: Method and Apparatus for Directional Resistivity...
ATTORNEY: G. Michael Roebuck TELEPHONE NO.: 713-266-1130
EXPRESS NO.: EV322404402US DOCKET NO.: 414-28483-US
SHEET 8 OF 10

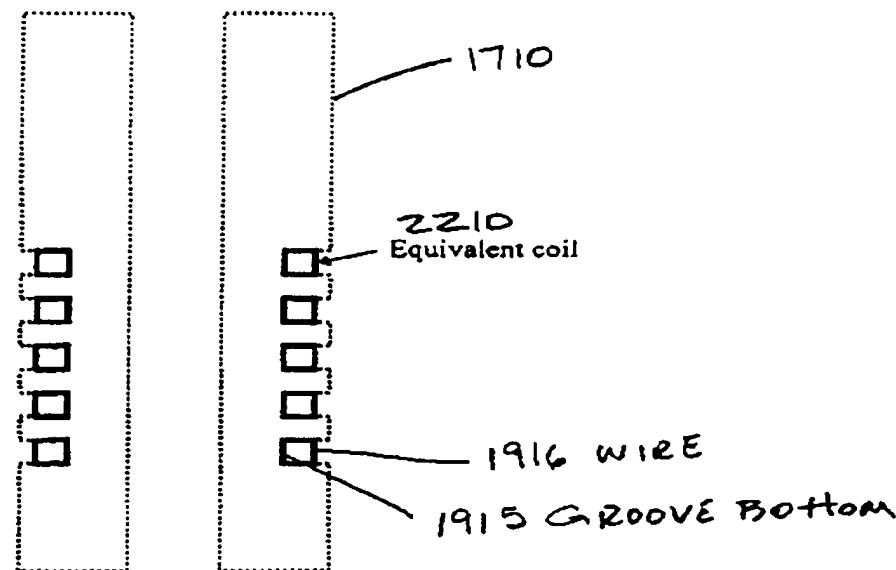


FIG. 9 The equivalent coil system for the transverse loop shown in FIG. 7. The small coils all have the same moment direction and therefore their contributions add to each other. The coil size is given by the gap between the wire and the groove bottom in FIG. 7

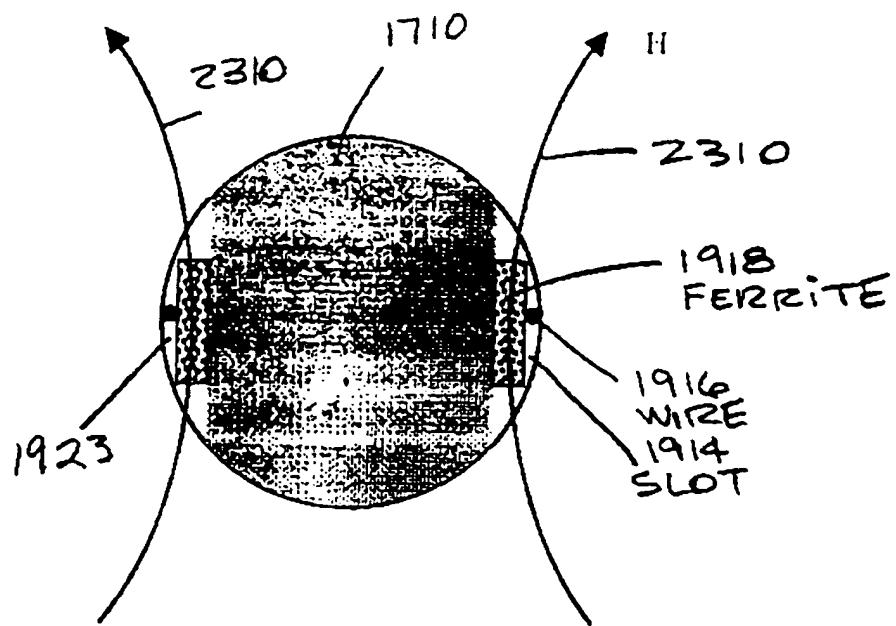


FIG. 10 Reception of magnetic field by a transverse coil.

INVENTOR: Wang et al.
TITLE: Method and Apparatus for Directional Resistivity...
ATTORNEY: G. Michael Roebuck TELEPHONE NO.: 713-266-1130
EXPRESS NO.: EV322404402US DOCKET NO.: 414-28483-US
SHEET 10 OF 10

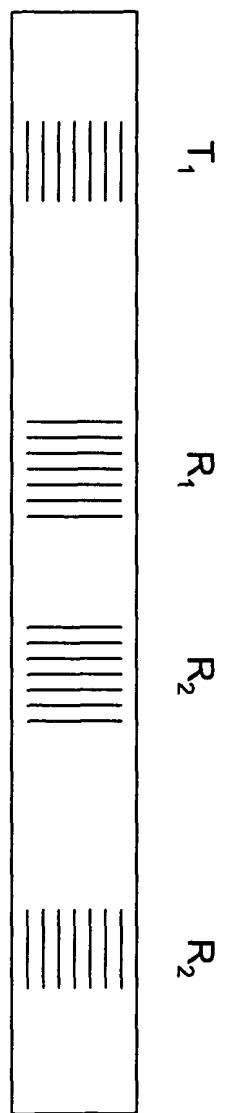


Figure 11. An arrangement of dual transmitters and dual receivers.